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SIZE GRADES FOR RIPE OLIVES

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By

Frederic T. Bioletti

Univ. of Calif. Agric. Expt. Station

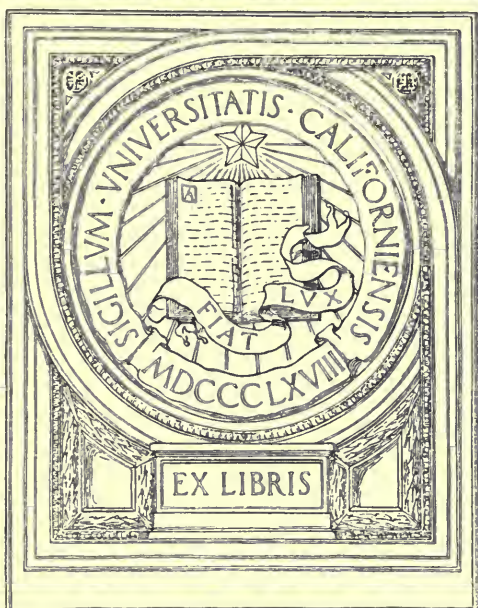
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SIZE GRADES FOR RIPE OLIVES

BY
FREDERIC T. BIOLETTI

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SIZE-GRADES FOR RIPE OLIVES

By FREDERIC T. BIOLETTI

Uses and Methods of "Sizing."—Pickled olives are sorted into several grades based on size. This is necessary for various reasons. When the sizes are mixed, the olives are less attractive in appearance. The large sizes have a greater commercial value. The price paid by the pickler to the grower depends on the size of the fruit. Finally, it is impossible to process olives of various sizes together with the best results.

Various devices are used to separate the various size-grades, but they all depend on the variations in the shortest diameter of the olive. The unit of measurement used is called a "sixteenth," which means a sixteenth of an inch. Olives with a diameter of less than 9 sixteenths are usually rejected for pickling. All above this size are separated into grades differing from each other by one or more sixteenths of an inch.

No accepted standard of grades has been established for olives as for prunes and raisins. An examination of the various brands of canned and bottled olives on the market shows great diversity both in the segregation of the various grades and in the methods of designating them. Uniformity in this matter is very desirable. The buyer wants to know exactly what he is getting; the seller needs to know exactly what the buyer is ordering.

Variations in Practice.—In order to determine the variations in practice and whether there was any tendency towards uniform standards, an examination was made of a number of samples of olives collected in the open market. Of these samples eighteen were in bottles and thirty-three in cans. They include the best brands of eleven picklers and handlers of northern, central, and southern California, and therefore represent the present practice fairly.

The examination included the volume of the container, the weight of the olives and of the brine, and the number of olives. Certain samples of typical sizes were carefully measured to determine variations in size. Some of the data obtained is given in the following table:

TABLE I
SIZE-GRADES OF COMMERCIAL RIPE OLIVES

Sample No.	Designation on can or bottle	Weight of Olives lbs.	Size of container	Number of Olives	Number of Olives per lb.	Mean diam. 16ths in.
5	Jumbo. Sevillano .....	.85	b 640 cc.	30	35.5	16.05
23	Jumbo. Net contents 1 qt.	1.22	.....	53	43.6	.....
22	Jumbo. Net weight 2 lbs.	1.12	.....	54	48.3	.....
19	Fancy	1.47	b 950	73	49.7	.....
20	Fancy .....	.26	b 225	14	53.4	.....
1	Fancy. Mission .....	.95	b 640	56	58.9	13.63
12	X Mission	1.02	b 665	63	61.4	13.60
6	No. 1 Mission .....	.88	b 640	54	61.5	13.70
9	Extra Fancy Mission and Manzanillo..	.99	b 700	64	64.6	13.30
13	XX Mission .....	.96	b 665	65	67.6	13.24
43	Large size. Contents 20 oz.	1.66	1035	112	68.0	.....
10	Fancy Mission	1.00	b 700	72	73.4	12.69
24	Fancy. 1 qt. net; 1 lb. 4 oz. net wgt..	1.37	970	100	73.0	.....
47	Fancy. Net wgt. 16 oz. ....	.53	485	39	73.0	.....
15	Mammoth size. Mission .....	.62	460	46	73.8	.....
25	Fancy. 1 pt. net; 10 oz. net wgt.....	.67	490	49	74.0	.....
37	Fancy. Net wgt. 16 oz. ....	.53	485	39	75.0	.....
14	XXX Mission	1.07	b 665	81	75.7	12.57
38	Fancy. 1 qt. net; 1 lb. 4 oz. net wgt..	1.30	970	100	76.0	.....
18	Mission .....	.65	b 475	50	77.4	.....
39	Fancy. 1 pt. net; 10 oz. net wgt. ....	.61	490	49	80.0	.....
2	Extra large. Mission	1.08	b 640	91	84.0	11.89
36	Fancy. Net wgt. 2 lbs.	1.05	965	91	86.0	.....
31	Net contents 1 pt.; wgt. olives min. 9 oz.	.57	485	50	87.0	.....
7	No. 2 Mission .....	.91	b 640	80	87.9	11.98
50	9 oz. net .....	.68	530	60	88.0	.....
44	Net wgt. olives min. 1 lb. 3 oz.	1.21	970	108	89.0	.....
46	Fancy. Net wgt. 2 lbs.	1.13	965	90	89.0	.....
16	Extra large size. Mission .....	.58	460	52	89.6	.....
48	Extra large size. 29 oz. net wgt.	1.14	855	103	91.0	.....
30	Net wgt. olives min. 1 lb. 3 oz.	1.19	970	111	92.0	.....
32	Extra large size. 29 oz. net wgt.	1.14	855	106	92.0	.....
45	Net contents 1 pt.; wgt. olives min. 9 oz.	.57	485	53	93.0	.....
29	Large size. Contents 20 oz.	1.25	1035	118	94.0	.....
11	Large Mission	1.10	b 700	106	95.9	11.55
28	Net wgt. 30-32 oz.	1.11	855	100	98.0	.....
21	Fancy .....	.14	b 150	14	98.6	.....
27	Net contents 15 oz. ....	.55	475	55	99.0	.....
51	Fancy	1.07	840	108	101.0	.....
35	9 oz. net .....	.60	530	61	102.0	.....
26	Contents, incl. brine, 1 lb. 13 oz.	1.08	860	111	103.0	11.57
34	18 oz. fruit net	1.21	.....	125	103.0	.....
3	Large. Mission	1.06	b 640	109	103.0	.....

NOTE.—Samples marked *b* were in bottles, the others in cans,

TABLE I—(Continued)
SIZE-GRADES OF COMMERCIAL RIPE OLIVES

Sample No.	Designation on can or bottle	Weight of Olives lbs.	Size of container	Number of Olives	Number of Olives per lb.	Mean diam. 16ths in.
42	Net wgt. 30-32 oz.	1.03	855	107	104.0	.....
40	Contents, incl. brine, 1 lb. 13 oz.	1.11	860	117	105.0	.....
41	Net contents 15 oz. ....	.61	475	65	105.0	.....
17	Large size. Mission ....	.60	460	66	110.0	.....
49	18 oz. fruit net	1.31	995	125	115.0	.....
4	Medium. Mission	1.04	b 640	133	127.1	9.95
33	15 oz. net wgt. ....	.58	.....	80	136.0	.....
8	No. 3 Mission ....	.89	b 640	139	156.4	9.98

NOTE.—Samples marked *b* were in bottles, the others in cans.

This table shows great variation in usage. Samples labeled *Jumbo* or *Mammoth* vary from 36 to 74 per pound; *Fancy* from 50 to 108; *Extra Large* from 84 to 106, and *Large* from 68 to 110. It is thus possible to buy olives labeled "Large" which require only 68 to make a pound, while "Mammoth" olives might require 74 and "Extra Large" 106.

It is desirable that the cans should be designated by words, numbers or signs that would give the buyer information on the size and weight of the olives he is buying, and also perhaps of the number in a can.

Tendency of Current Practice.—There seems to be a general tendency to distinguish by descriptive words five sizes. These are (1) *Jumbo*, *Mammoth* or *Extra Fancy*; (2) *Extra Large* or *Fancy*; (3) *Large*; (4) *Medium*; (5) *Small*. Some label their various sizes 1, 2, 3, etc.; others X, XX, XXX. Table II shows that the first four sizes include olives whose average diameter range from 16 sixteenths to 10 sixteenths of an inch. Those smaller than this are not often pickled for the general market. While this general tendency exists, the individual variations are very great and the words, numbers and signs of the various brands have no common standard or meaning.

Basis for a Common Standard.—In order to establish the basis for a common standard, an attempt was made to discover the relation between diameter and number per pound. The data in Table II indicate that this is not a fixed ratio. It varies in fact according to the shape of the olive and its specific gravity. With the same diameter it will require more olives of a rounded variety, like the *Manzanillo*, to weigh a pound than of an elongated variety, like the *Sevillano*.

Fresh olives will weigh less than pickled olives of the same size and shape, owing to the salt contained in the latter.

TABLE II
RELATION OF DIAMETER TO WEIGHT AND DESIGNATION

Sample No.	Designation	Diameter in 16ths of an inch			Length Mean L	Number per lb.	L/D
		Max.	Min.	Mean D			
5	Jumbo	17.12	15.04	16.05	21.41	35.5	1.334
6	No. 1	15.04	12.80	13.70	18.32	61.5	1.338
1	Fancy	14.88	12.64	13.63	18.05	58.9	1.357
12	X	14.08	13.12	13.60	16.48	61.4	1.212
9	Extra Fancy	13.76	12.48	13.30	17.17	64.6	1.291
13	XX	14.40	12.48	13.25	16.59	67.6	1.252
10	Fancy	14.08	11.68	12.69	17.62	73.4	1.388
14	XXX	13.44	12.00	12.57	15.74	75.7	1.250
7	No. 2	12.80	11.36	11.98	15.90	87.9	1.327
2	Extra Large	12.48	11.36	11.89	16.56	84.0	1.393
3	Large	12.00	10.24	11.57	15.87	103.0	1.372
11	Large	12.32	10.24	11.55	15.55	95.9	1.346
8	No. 3	10.72	8.64	9.98	14.00	156.4	1.402
4	Medium	10.40	9.28	9.95	14.57	127.1	1.466

For olives of the same shape and specific gravity the number per pound will vary inversely as the cube of the diameter. For example, an olive whose diameter is 16 sixteenths will weigh 8 times as much as a similar olive whose diameter is only 8 sixteenths. It will therefore require 8 times as many of the latter as of the former to weigh a pound.

While the olives of a given variety vary somewhat in shape, according to stage of development and other factors, these variations lie normally within certain limits and the average shape of well-developed olives of any variety is fairly constant. This makes it possible to find a factor which will enable us to calculate the number of olives per pound for any diameter of a given variety with a fair degree of accuracy. This factor will be different for each variety of different shape and will depend particularly on the elongation of the olive or the ratio between length and thickness.

From a large number of weighings and measurements, a factor has been determined for each of several of our principal pickling olives and from this factor the number of olives to the pound for the various sizes. The results are shown in Table III.

TABLE III
RELATION OF DIAMETER TO NUMBER PER POUND FOR VARIOUS VARIETIES
OF OLIVES (PICKLED)

Number per pound = $K \div D^3$

Diameter	Manzanillo No. 1	Ascolano	Agostino	Cucco	Fairoaks	Average	Mission
8	313	290	286	264	257	282	*244
9	220	204	199	186	181	198	*190
10	160	148	146	135	132	144	142
11	121	112	110	102	99	109	107
12	93	86	85	78	75	83	82
13	75	68	67	61	60	66	65
14	58	54	53	49	47	52	52
15	48	44	43	40	39	43	42
16	39	36	36	33	32	35	35
17	33	30	30	28	27	30	29
L/D	1.168	1.238	1.288	1.303	1.392	.....	1.328

K = Number of olives per pound of size 10 multiplied by 1000.

L = Average length of olive.

D = Average thickness of olive or diameter.

L/D = Average ratio of length to thickness.

* The numbers corresponding to diameters 8 and 9 for the Mission were determined by actual weighings of these sizes. The numbers are slightly lower than would be found by calculation, owing to the fact that the undeveloped olives are more elongated than those over 10.

From this table it is possible to find the number of olives required for a pound of the various sizes of the different varieties. The dependence of the number on the ratio of length to thickness, L/D, is clearly shown. Of the Fairoaks variety, which is 1.392 times as long as wide, 257 olives of the 8 sixteenths size weigh one pound, while of the Manzanillo No. 1, which is only 1.168 times as long as wide, 313 of the same size are necessary. The numbers for the smaller sizes 8 to 10, inclusive, are probably a little high. The measurements used to determine the factor K were made on olives ranging from 10 to 16 sixteenths. Olives smaller than this are usually undeveloped and are more elongated than the type. They will, therefore, be heavier in proportion to their diameters and it will require less proportionately to weigh a pound.

The number of size grades which it is *desirable* to separate depends on the objects to be accomplished. The number which it is *possible* to separate depends on the perfection of the grading machine or device used.

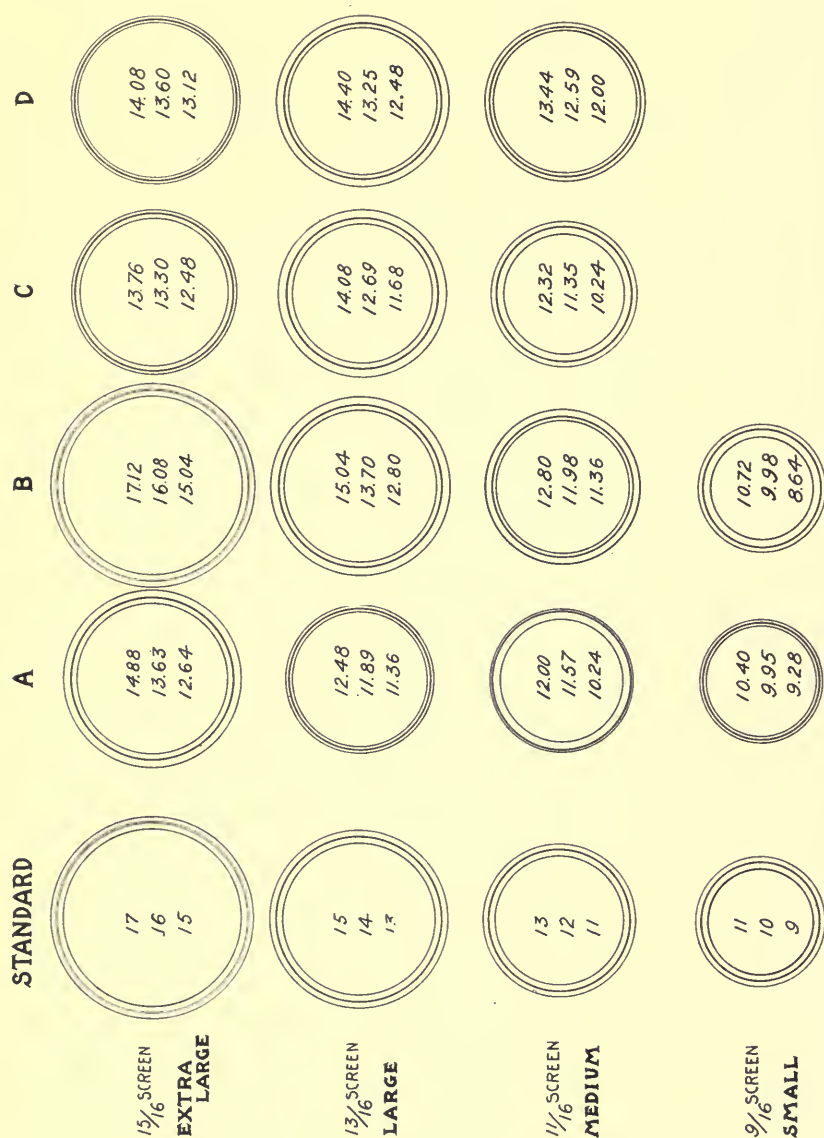


Fig. 1.—A, B, C, D. Maximum, Minimum, and Average diameters of the olives of various grades of four different picklers. *Standard*. Size-grades obtained by using four screens differing by 2 sixteenths of an inch.

In figure 1 is shown in diagrammatic form the sizes and variations found in the various grades of four of the largest picklers of ripe olives in California. A glance at this diagram shows that picklers A and B separate their olives into four fairly distinctive size-grades. Picklers C and D appear not to have had any very large olives and, in grading, probably simply eliminated the fruit that was too small.

Table IV shows the differences between the average sizes of the various grades for each pickler and the range from the largest olive to the smallest.

TABLE IV
DIFFERENCES BETWEEN GRADES (in sixteenths of an inch)

	Grades			Average	Total range
	1-2	2-3	3-4		
Pickler A	1.74	.32	1.62	1.23	5.60
Pickler B	2.38	1.72	2.00	2.03	8.48
Pickler C .....	.61	1.34	.....	.98	3.52
Pickler D .....	.35	.66	.....	.51	2.08

Table V shows the extreme variation in size of olives in each grade for the same picklers.

TABLE V
VARIATIONS IN EACH GRADE (in sixteenths of an inch)

	Grades				Average	Total range
	1	2	3	4		
Pickler A.....	2.24	1.12	1.96	1.12	1.56	5.60
Pickler B.....	2.06	2.24	1.44	2.08	1.96	8.48
Pickler C.....	1.26	2.40	2.08	.....	1.91	3.52
Pickler D.....	.96	1.90	1.44	.....	1.44	2.08

The most methodical grading is evidently that of B. Although including a larger range of sizes of olives, the differences between grades and the variations within the grades are more uniform than those of any of the others.

As all sizes of olives between the extremes of the largest and the smallest are likely to occur, the range of variation within each grade should be equal to the difference between the average sizes of two adjacent grades, where the grading is done accurately. This condition is most closely approximated by B, where the range of variation and difference between grades is very close to 2 sixteenths.

It would seem, then, that a difference of 2 sixteenths between grades would be suitable. There is no advantage in having the average

size of two adjacent grades closer than the variation within a grade, as in C and D. This variation exceeded 2 sixteenths with all the picklers except D, and in this case it was very near to this figure.

The grading illustrated in figure 1 under "Standard" is based on this difference of 2 sixteenths.

As the olives are graded before processing, the sizes of the fresh olives indicated in the diagram would not necessarily be exactly the same as those of the pickles, but the difference would be slight. Tests made show that there may be increase in size of a little over 2 per cent.

TABLE VI
INCREASE OF SIZE IN PICKLING

	Fresh Olives	Pickled Olives	Increase	Variety
Sample 1	13 sixteenths	13.36	= 3%	Manzanillo No. 1
Sample 2	13 sixteenths	13.31	= 2.4%	Agostino
Sample 3	13 sixteenths	13.24	= 1.9%	Cuceo
Sample 4	11 sixteenths	11.15	= 1.4%	Fairoaks
Average increase			= 2.175	

Table VII gives the principal data regarding the standard for size-grades which corresponds nearest to the present practice. It divides the olives usually pickled into three size-grades, 1, 2, and 3, called respectively *Extra Large*, *Large*, and *Medium*. These are all over 11 sixteenths before pickling. The smaller olives, if pickled, could be divided into two other grades, 4 and 5, called *Small* and *Extra Small*. Size 1 would include all olives which failed to pass through a 15 sixteenth screen, size 2 those retained by a 13 sixteenths, and so on. The fourth column gives the approximate average size of the pickled olives and the fifth column the number of pickled olives to the pound, varying according to variety.

TABLE VII
STANDARD FOR SIZE-GRADES

(Based on present practice; difference 2 sixteenths inch)

	Size	Range	Average	Number per lb.
Extra large	1	17-15	16	32 to 39
Large	2	15-13	14	47 to 58
Medium	3	13-11	12	75 to 93
Small	4	11- 9	10	132 to 160
Extra small	5	below 9	?	?

Table VIII shows the average number per pound for each size for our commonest pickling varieties. The actual sizes of the four grades are shown in figure 1 under "Standard."

TABLE VIII

NUMBER PER POUND OF COMMON VARIETIES WITH THE PRESENT GRADING

Designation	Retaining screen*	Average diameter*	Average number per lb.			
			Mission	Sevillano	Ascolano	Manzanillo No. 1
Extra large	15	16	35	33	36	39
Large	13	14	52	49	54	58
Medium	11	12	82	78	86	93
Small	9	10	142	135	148	160

* These numbers represent sixteenths of an inch.

Proposed Improved Standards.—It has been proposed to make a closer segregation of sizes than is made by this standard. Some picklers advocate a series of size-grades differing by 1 sixteenth. This would result in an over-lapping of the grades that would be a source of confusion. Olives of the same weight would go into different grades according to their shape. An elongated olive would go into a lower grade than a rounded olive of the same weight. A somewhat flattened olive would go into a higher grade than a round olive of the same weight. There will of course be a certain amount of this over-lapping, whatever the standard adopted, but it will be negligible with a size-difference of 2 sixteenths, but considerable with one of 1 sixteenth.

A more perfect and logical grading would be one that was based, not on an absolute difference of diameter between the size-grades, but on a percentage difference. If the largest grade was the same percentage larger than the second largest, as this was than the third largest, and so on, the result would be a closer grading of the smaller sizes where it is most needed.

For example, an olive with a diameter of 8 sixteenths weighs only 70 per cent as much as an olive of 9 sixteenths, while an olive of 15 sixteenths weighs 82 per cent as much as an olive of 16 sixteenths. In the first case the difference is readily perceptible to the eye; in the other, it is hardly noticeable. A grading based on a percentage difference avoids this difficulty. Such a grading is shown in Table IX.

TABLE IX
PROPOSED STANDARD FOR SIZE-GRADES
(Based on a percentage difference)

Designation	Retaining screen	Average diameter of Olives	Difference between grades	Average number per lb.	
				Mission	Other varieties
Fancy	15.0	16.0	.....	35	32-39
Extra large	13.2	14.1	1.9	51	46-57
Large	11.6	12.4	1.7	75	68-83
Medium	10.2	10.9	1.5	111	100-124
Small	9.0	9.6	1.3	162	146-180

By this method the difference between grades gradually increases from 1.3 sixteenths between the smallest grades to 1.9 sixteenths between the largest. Each grade has almost exactly 88 per cent the average diameter of the next larger grade and weighs 68 per cent as much. The number of olives to the pound would be inversely proportionate to the weight and the number for each grade would be 68 per cent of the next smaller grade.

This method of dividing the size-grades would, from many points of view, be preferable to those now in use. It appears to be as close a grading as is possible in view of the irregularity in the shape of olives of all varieties. It would insure a closer grading than the present system. Olives about 9 sixteenths would be separated into five size-grades, instead of into four, as is the present custom.

PROPOSED SIZE-GRADES FOR OLIVES

1. *Fancy*. All which are retained by a screen of 15 sixteenths mesh. Average diameter of olives, about 16 sixteenths. Average weight for Mission variety, 35 to the pound.

2. *Extra Large*. All which pass a 15 but fail to pass a 13.2 sixteenths mesh. Average diameter of olives, 14.1 sixteenths. Average weight for Mission, 51 to the pound.

3. *Large*. All which pass a 13.2 but fail to pass an 11.6 sixteenths mesh. Average diameter of olives, 12.4 sixteenths. Average weight for Mission, 75 to the pound.

4. *Medium*. All which pass an 11.6 sixteenths, but fail to pass a 10.2 sixteenths mesh. Average diameter of olives, 10.9 sixteenths. Average weight for Mission, 111 to the pound.

5. *Small*. All which pass a 10.2 sixteenths, but fail to pass a 9 sixteenths mesh. Average diameter of olives, 9.6 sixteenths. Average weight for Mission, 162 to the pound.

Some of the best size-grading machines for olives do not make use of perforated screens but of tapering or adjustable slots. It is possible to adjust such a grader to any standard of sizes. Some picklers adjust the grader so that it divides the olives into size-grades having each a specified number of olives per pound.

In one factory four size-grades are made, having respectively 60, 72, 90, and 120 olives to the pound. For Mission olives these numbers represent average diameters of 13.3, 12.4, 11.6, and 10.6 sixteenths, or

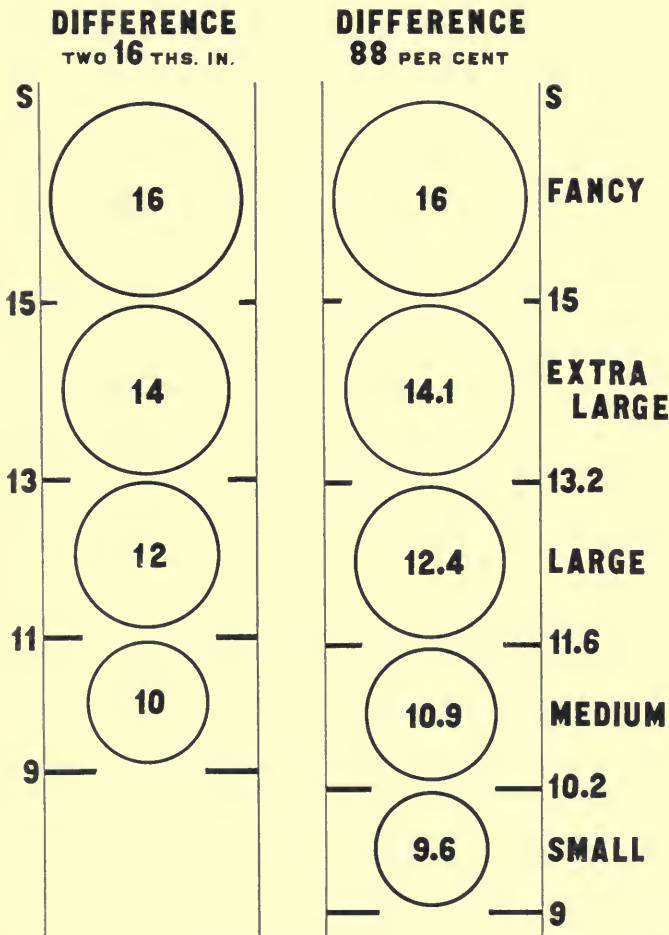


Fig. 2.—Comparison of the most usual present system with the proposed system.

Right column: Four size-grades of most common present system.

Left column: Five size-grades of proposed percentage system.

The numbers in the circles show the average diameter of the olives; the numbers at each side show the diameter of the holes in the sorting screens.

the grading that would be obtained by screens of 10, 11, 12, and 13 sixteenths of an inch. The objections to this close grading have already been shown, and also to the adoption of an absolute difference instead of a percentage difference.

COMPARISON OF VARIOUS SYSTEMS OF SIZE-GRADING

- A. Size-grades differing by 2 sixteenths of an inch.
- B. Size-grades differing by 88 per cent in diameter and 68 per cent in weight.
- C. Nearest approximation to system B that can be made with screens differing by thirty-seconds of an inch.

DIAMETER OF PERFORATIONS OF SCREENS (in sixteenths of an inch)

A	15	13	11	.....	9
B	15	13.2	11.6	10.2	9
C	15	13	11.5	10	9

DIAMETER AND WEIGHT OF OLIVES OF EACH GRADE

Average diameter			Olive Grades	No. of Olives per lb.		
A	B	C		A	B	C
16	16	16	Fancy	35	35	35
14	14.1	14	Extra large	52	51	52
12	12.4	12¼	Large	82	75	77
10	10.9	10¾	Medium	142	111	114
....	9.6	9½	Small	.....	162	166
<9	9	9	Culls	.....	.....	.....

SUMMARY AND CONCLUSIONS

1. The separation of olives into size-grades is necessary for the best results in pickling and marketing.
2. No standard has been established for size-grades.
3. There is much lack of uniformity in present practice.
4. Some picklers simply eliminate all small olives, usually those whose shortest diameter is less than 10 or 11 sixteenths. Other picklers divide the olives above 9 sixteenths into three or four grades differing by 2 sixteenths.
5. Some picklers consider that this grading is not fine enough and advocate grades differing by only 1 sixteenth.
6. A difference of 1 sixteenth is unnecessarily fine, as adjoining grades would be almost indistinguishable, especially with the larger

sizes. This small difference is also impracticable owing to irregularities in the shape of the olives.

7. A grading based on any absolute difference between all sizes is imperfect. If suitable to the larger sizes, it will be too coarse for the smaller; if suitable for the smaller, it will be too fine for the larger.

8. A more suitable grading would be one based on a percentage difference; one in which each size was a certain per cent of the next larger size.

9. A grade based on a difference in diameter of 88 per cent is proposed. This would increase the number of size-grades above 9 sixteenths from four, which is usual now, to five. It would decrease the absolute difference between the smallest sizes to 1.3 sixteenths, while that between the largest sizes would be 1.9 sixteenths.

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1915. Report of the College of Agriculture and the Agricultural Experiment Station, July, 1914-June, 1915.

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